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PATENT SPECIFICATION

DRAWINGS ATTACHED

Inventor: GEORGE EDWARD DRAKEFORD

992,631

992,631

Date of filing Complete Specification Oct. 24, 1961.

Application Date Nov. 1, 1960. *No. 37423/60.*

Complete Specification Published May 19, 1965.

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Index at acceptance: —B7 C(3B2, 3B7, 5E3, 5F, 74E)

Int. Cl.:—B 29 h, B 62 g

COMPLETE SPECIFICATION

Improvements in or relating to Pneumatic Tyres

ERRATUM

SPECIFICATION No. 992,631
Amendment No. 1

Page 1, line 7, *for* "statemnt" *read* "statement"

THE PATENT OFFICE
8th June 1965

axially outwardly with respect to the tyre. A disadvantage of this construction is that the adjacent cords in each ply layer lying within the portion of the sidewall so deflected, are forced apart from one another, placing the rubber between the cords in tension and thus weakening the tyre in the deflected region. Moreover, because the rubber between adjacent cords is placd in tension, cracks may eventually appear in the rubber between the cords which will shorten the useful working life of the tyre.

When the plies are formed from rubberised steel cords another disadvantage is that in the bead regions, particularly, the rubber between the cords at the ends of the plies tends to become detached so that the cords protrude from the plies and cut into the surrounding rubber of the tyre.

According to the present invention a pneumatic tyre comprises a tread reinforcement disposed beneath the tread region of the tyre,

[*Price* 4*s*. 6*d*.]

respect to the mid circumferential plane of the tyre.

Normally, the cord material in the half plies is formed from steel, but in the case of tyres for relatively light duties, e.g. light motor car tyres, textile cords may be used.

Preferably, the cords of the other ply or plies in the carcass of the tyre are disposed at an angle of 90° to the mid-circumferential plane, but the cords of some or all of these plies may extend across the said plane at angles of less than 90°. Preferably in the latter case for each of these plies there is another ply extending at the same angle but in the opposite direction across the plane.

Each bead region of the tyre may be provided with a steel or textile bracing strip to reinforce the bead construction of the tyre.

Tyres of the form defined above may be constructed without the usual bead wires, the function of the bead wires in holding the tyre on to a wheel rim being carried out by the

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COMPLETE SPECIFICATION

Improvements in or relating to Pneumatic Tyres

We, DUNLOP RUBBER COMPANY LIMITED, a British Company of 1 Albany Street, London, N.W.1, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statemnt:—

This invention relates to pneumatic tyres and methods of manufacturing them.

In the conventional construction of a pneumatic tyre the cords of each ply extend across the carcass of the tyre, in side-by-side relationship, in a direction at an angle to the mid-circumferential plane of the tyre, with the cords of adjacent plies extending in opposite directions with respect to the said plane. When an inflated tyre is placed under load during normal use, the portion of the tread region of the tyre in contact with the ground is deflected radially inwardly and the adjacent sidewall portions are consequently deflected axially outwardly with respect to the tyre. A disadvantage of this construction is that the adjacent cords in each ply layer lying within the portion of the sidewall so deflected, are forced apart from one another, placing the rubber between the cords in tension and thus weakening the tyre in the deflected region. Moreover, because the rubber between adjacent cords is placd in tension, cracks may eventually appear in the rubber between the cords which will shorten the useful working life of the tyre.

When the plies are formed from rubberised steel cords another disadvantage is that in the bead regions, particularly, the rubber between the cords at the ends of the plies tends to become detached so that the cords protrude from the plies and cut into the surrounding rubber of the tyre.

According to the present invention a pneumatic tyre comprises a tread reinforcement disposed beneath the tread region of the tyre, and a carcass each sidewall of which is provided with a half ply extending from the associated bead region and up the sidewall to terminate beneath the side of the tread region nearest the said sidewall, said half ply being formed from cord material which extends in a circumferential direction around the tyre in a plurality of spiral convolutions, the convolutions being parallel to one another and lying in side-by-side relationship, and at least one other ply being provided, said ply extending from one bead region to the other bead region and comprising parallel cords disposed at an angle of at least 45° to the mid-circumferential plane of the tyre.

Preferably the tyre incorporates a rigid tread reinforcement layer or layers extending from one side of the tread to the other, the layer or layers comprising cords of substantially inextensible material, e.g. steel cords, disposed at an angle less than 30°, e.g. 20° with respect to the mid-circumferential plane of the tyre.

Normally, the cord material in the half plies is formed from steel, but in the case of tyres for relatively light duties, e.g. light motor car tyres, textile cords may be used.

Preferably, the cords of the other ply or plies in the carcass of the tyre are disposed at an angle of 90° to the mid-circumferential plane, but the cords of some or all of these plies may extend across the said plane at angles of less than 90°. Preferably in the latter case for each of these plies there is another ply extending at the same angle but in the opposite direction across the plane.

Each bead region of the tyre may be provided with a steel or textile bracing strip to reinforce the bead construction of the tyre.

Tyres of the form defined above may be constructed without the usual bead wires, the function of the bead wires in holding the tyre on to a wheel rim being carried out by the

[*Price* 4s. 6d.]

circumferential cords. Preferably in this case an additional layer of circumferential spirally wound cord is provided in the bead region, the half-ply and the additional layer being disposed one on each side of the other ply.

According to the invention also a method of manufacturing a pneumatic tyre having a pair of half plies formed from spirally wound circumferentially extending cord material, one in each sidewall of the tyre, comprises forming each half ply into substantially its final moulded shape by winding a series of spiral convolutions of cord material in side-by-side relationship and parallel to one another around the profiled surface of a sidewall profile former, positioning the sidewall profile formers to locate the half plies symmetrically one on each side of and coaxially with respect to a tyre building former carrying the carcass of the tyre in a substantially cylindrical condition, and expanding the carcass radially outwardly between the half plies and positioning the half plies upon the expanded carcass.

The sidewall rubber coverings of the tyre may be positioned upon the carcass after the profile formed half plies have been added, but, preferably, each sidewall rubber covering is positioned within a profile former and the convolutions of cord material are wound upon it to form one of the half plies, the sidewalls then being added to the tyre carcass with the half plies.

Embodiments of the invention will now be described by way of example, with reference to the accompanying drawings, in which:—

Figure 1 is a diagrammatic perspective partly cut-away view of part of a pneumatic tyre mounted on a wheel rim;

Figure 2 is a diagrammatic perspective view showing apparatus for use in the construction of a pneumatic tyre and a portion of said tyre in course of construction;

Figures 3 and 4 are diagrammatic cross-sectional views showing further stages in the construction of the pneumatic tyre part of which is shown in Figure 1;

Figure 5 is a diagrammatic perspective view showing a stage in the construction of an alternative tyre.

A giant tyre 1 (see Figure 1) for use with commercial vehicles comprises two carcass reinforcing plies 2 and 3 each formed from a plurality of rubberised nylon cords lying in side-by-side relationship and extending across the tyre in a direction normal to the mid-circumferential plane of the tyre. Each of the plies extends across the tyre from one bead region 4 to the other bead region (not shown), the ends 5 and 6, respectively, of the plies 2 and 3 being turned up around inextensible bead wires 7 to terminate in the bead regions. A rigid tread reinforcement 8 extends circumferentially around the tyre beneath the tread 9. The tread reinforcement 8 consists of two layers 10 and 11, respectively, of rubberised parallel steel cord fabric, the cords of the layers each being disposed at 20° to the mid-circumferential plane of the tyre, the cords of the layer 10 crossing the cords of the layer 11.

Each sidewall 12 of the tyre 1 is provided with a half ply 13, the cords of which are formed by a single length of rubberised steel cord 14 wound spirally in a circumferential direction around the tyre in a plurality of convolutions 15, the convolutions being parallel to one another and lying in side-by-side relationship. Each of the half plies 13 is positioned in the axially outer sidewall region of the tyre and extends up its associated sidewall 11 from a position 16 axially outside the bead to terminate in a position 17 beneath the nearer edge 18 of the tread reinforcement 8.

A bracing strip 19 formed from substantially parallel rubberised steel cords 20 is provided in each bead region 4 of the tyre. The strip 19 extends around the bead wire 7 from the interior of the tyre to the exterior of the tyre to overlap the radially inner end 16 of the half ply 13. The cords of the bracing strip 19 extend in a direction at 30° to the circumferential direction of the tyre.

The manufacture of the tyre described above is illustrated in Figures 2—4. The carcass 21 of the tyre, comprising an inner lining 22 of unvulcanised rubber, the bead wires 7, an apex strip 23, and the plies 2 and 3, is built in substantially cylindrical shape (see Figure 3) on an expansible tyre building former (not shown).

The two half plies 13 are formed initially into substantially the shape they will have in the finally moulded tyre. This is accomplished by providing for each of the half plies an annular profile former 24 the profiled surface 25 of which is shaped to correspond to the moulded shape of the tyre sidewall. Each former 24 is positioned on a horizontal rotatable table 26 (see Figure 2) with its profiled surface uppermost. A sidewall rubber covering 27, chafer strip 28, the bracing strip 19 and a strip of rubber inner lining material 29 are positioned coaxially with the former upon the profiled surface, and the length of steel cord 14 is wound around the former on top of the sidewall rubber and bracing strip, in a plurality of spiral convolutions so that the convolutions lie side-by-side in parallel relationship, each succeeding convolution lying at a larger diameter than the preceding convolution. The winding is performed by rotating the table 26 and thus the former 24, and guiding and pressing the cord 14 into position on the sidewall rubber by means of a tool 30 consisting of a freely rotatable grooved guide pulley 31 carried on a support 32 which may be manually or mechanically moved radially with respect to the former to lay the convolutions 15 in the desired positions. A strip 33 of material to which un-

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vulcanised rubber will not adhere (e.g. of polyethylene sheet material) is placed on the sidewall rubber 27 to underlie the outermost portion of the half ply 13 for a purpose to be described.

The profile formers 24 are then positioned one on each side of the carcass 21 (see Figure 3), so that the two half plies 13 which are contained within them are disposed coaxially with respect to the carcass and in engagement with the bead regions of the carcass. The carcass 21 is then expanded radially outwardly in the crown region symmetrically with respect to the mid-circumferential plane, by expanding the former on which it is supported, and is formed into a toroidal shape between the profile formers 24, the bead wires 7 and profile formers 24 axially approaching one another to the position shown in Figure 4. On further expansion of the carcass it contacts the half plies 13 upon the formers 24 as shown in Figure 4.

The profile formers 24 are now removed, the bracing strips 19, chafers 28, and inner lining portions 29 are turned around their respective bead wires 7 in the conventional manner, and the inner lining portion 29 is joined to the remainder of the inner lining 22.

The radially outermost portions 27*a* of the sidewall rubber coverings 27 are now peeled back and the strips 33 are removed, thus exposing the outermost portion of the half ply 13. The layers 10 and 11 of the tread reinforcement are now applied to the carcass 21 in the position shown in Figure 1, the edges of the layers 10 and 11 overlying the radially outermost portions of the half plies 13. An unvulcanised rubber tread 9 is then applied and the portions 27*a* of the sidewall replaced and consolidated in position. The completed tyre is then placed in a tyre mould and moulded and vulcanised in the conventional manner.

Figure 5 illustrates the production of an alternative form of the tyre according to the invention, in which no bead wires are provided. A carcass 34 is formed by placing an inner lining 35 of unvulcanised rubber on a suitably shaped former (not shown), winding an annular disc-shaped reinforcement layer 36 from circumferentially-extending spiral convolutions of rubberised steel cord on the radially-extending portions 35*a* of the inner lining, and then laying a ply 37 over the lining 35 and reinforcement 36. The ply 37 consists of rubberised parallel steel cord fabric having its cords disposed at 90° to the mid-circumferential plane of the former.

A pair of half plies 38, similar to the half plies 13 described above are formed from rubberised steel cord by winding the cord on sidewall rubber coverings 39 and chafer strips 40 carried in profile formers 41. The formers 41 are located coaxially one on each side of the carcass 34 and moved towards one another to press the half plies 38 into contact with the ply 37, the ply 37 being sandwiched in each bead region between the layer 36 and the half ply 38. The carcass 34 is then expanded radially outwardly to the position shown in dotted lines in Figure 5 the reinforcement layers 36 and profile formers 41 axially approaching one another and the assembly of the tyre then proceeds in a similar manner to that of the tyre described with reference to Figures 1—4 of the drawings.

In a third embodiment of the invention (not illustrated), an aeroplane tyre comprises two radially-inner plies extending from one bead region across the tyre to the other bead region, the plies being formed from a plurality of rubberised parallel steel cords extending across the tyre in a direction normal to the mid-circumferential plane of the tyre. Each bead region is provided with two bead wires, the construction of the tyre within the bead region and the method of wrapping the ends of the plies around the first and second bead wires being as described in the specification of our copending British Patent Application No. 8042/57 (Serial No. 854971).

The tyre is otherwise constructed in a similar manner to that described in the first embodiment, having a tread reinforcement beneath the tread region, a pair of steel bracing strips, one in each bead region, and a pair of half plies, one in each sidewall, each of these half plies having a circumferentially-extending steel cord formed in parallel spiral convolutions around the tyre.

In a fourth embodiment of the invention (not illustrated), a car tyre is of similar construction to that described in the first embodiment, but instead of having two inner bead to bead carcass plies, it is provided with one inner bead to bead carcass ply of textile cords only, the cords extending in a direction normal to the mid-circumferential plane of the tyre. Bracing strips are not required within the bead regions of the tyre to reinforce the bead construction.

The advantage of incorporating a half ply with circumferentially-extending spirally wound cord, constructed as described above, in each sidewall of the tyre, is that when the tyre is deflected during use, the cords of each of these half plies will not be forced apart as are the cords of the plies in normal tyre constructions, thereby weakening the tyre, but will be forced closer together by virtue of the radially-inward movement of the tyre in the tread region and will, therefore, give greater strength to the tyre within that region, the region in which most strength is required. The circumferentially-extending cords of the half plies also serve to "tie together" the cords of the other ply or plies, tending to prevent these cords from being forced apart from one another on deflection of the tyre and thus

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avoiding the setting up of tension in the rubber between the cords. This helps to reduce the cracking which may occur as a result of the rubber between the cords being subjected to tensile stress.

The rubber surrounding the half plies formed from the convolutions of steel wire and embedded between the convolutions may be from 30° to 90° Shore hardness. Preferably, however, the hardness is from 85° to 90° Shore.

WHAT WE CLAIM IS:—

1. A pneumatic tyre comprising a tread reinforcement disposed beneath the tread region of the tyre, and a carcass each sidewall of which is provided with a half ply extending from the associated bead region and up the sidewall to terminate beneath the side of the tread region nearest the said sidewall, said half ply being formed from cord material which extends in a circumferential direction around the tyre in a plurality of spiral convolutions, the convolutions being parallel to one another and lying in side-by-side relationship, and at least one other ply being provided, said ply extending from one bead region to the other bead region and comprising parallel cords disposed at an angle of at least 45° to the mid-circumferential plane of the tyre.

2. A pneumatic tyre according to claim 1 wherein a rigid tread reinforcement is provided, said tread reinforcement comprising a layer or layers of rubberised substantially inextensible filamentary material disposed at an angle less than 30° with respect to the mid-circumferential plane of the tyre.

3. A pneumatic tyre according to either of claims 1 or 2 wherein the cords of the ply extending from one bead region to the other bead region are each disposed at 90° to the mid-circumferential plane of the tyre.

4. A pneumatic tyre according to any of the preceding claims wherein the cord of each half ply is of steel.

5. A pneumatic tyre according to any of the preceding claims wherein no bead wires are provided.

6. A pneumatic tyre according to claim 5 in which an annular disc-shaped reinforcement layer formed from circumferentially extending spiral convolutions of steel cord is provided, the ply which extends from one bead region of the tyre to the other bead region being sandwiched in each bead region between said layer and the associated half ply.

7. A pneumatic tyre according to any of the preceding claims 1—5 wherein a bracing strip is provided in each bead region.

8. A method of manufacturing a pneumatic tyre having a pair of half plies formed from spirally wound circumferentially extending cord material, one in each sidewall of the tyre, comprising forming each half ply into substantially its final moulded shape by winding a series of spiral convolutions of cord material in side-by-side relationship and parallel to one another around the profiled surface of a sidewall profile former, positioning the sidewall profile formers to locate the half plies symmetrically one on each side of and coaxially with respect to a tyre building former carrying the carcass of the tyre in a substantially cylindrical condition, and expanding the carcass radially outwardly between the half plies, and positioning the half plies on the expanded carcass.

9. A method according to claim 8 wherein a pair of annular unvulcanised rubber sheets to form the sidewall coverings of the tyre are positioned coaxially within the profile formers, the convolutions of cord material to form the half plies then being wound upon the rubber sheets, and the rubber sheets being added to the tyre carcass together with the half plies.

10. A pneumatic tyre constructed and arranged substantially as described herein and shown in Figure 1 of the accompanying drawings.

11. A pneumatic tyre having a bead reinforcement constructed and arranged substantially as described herein and shown in Figure 5 of the accompanying drawings.

12. A method of manufacturing a pneumatic tyre substantially as described herein and shown in Figures 2—4 of the accompanying drawings.

13. A method of manufacturing a pneumatic tyre substantially as described herein and shown in Figure 5 of the accompanying drawings.

14. A pneumatic tyre in the construction of which a method according to any of claims 8, 9 or 12 is used.

15. A pneumatic tyre in the construction of which a method according to claim 13 is used.

C. H. BOWYER,
Agent for the Applicants.

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992631 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

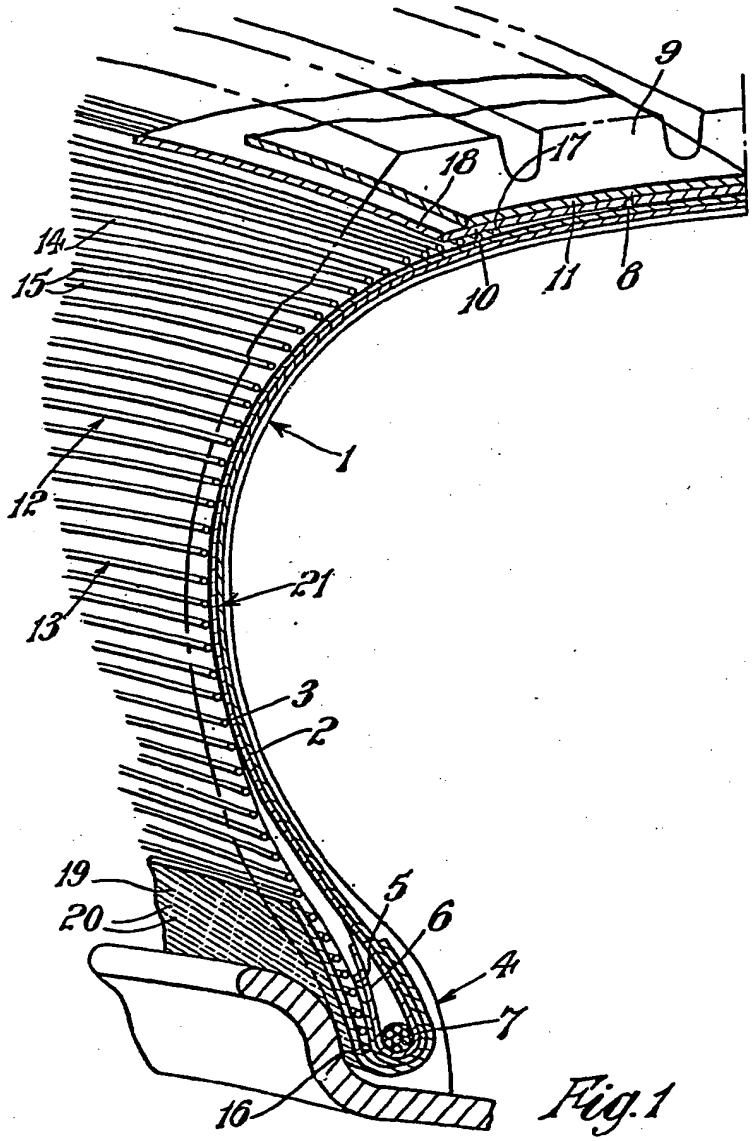

Fig. 1

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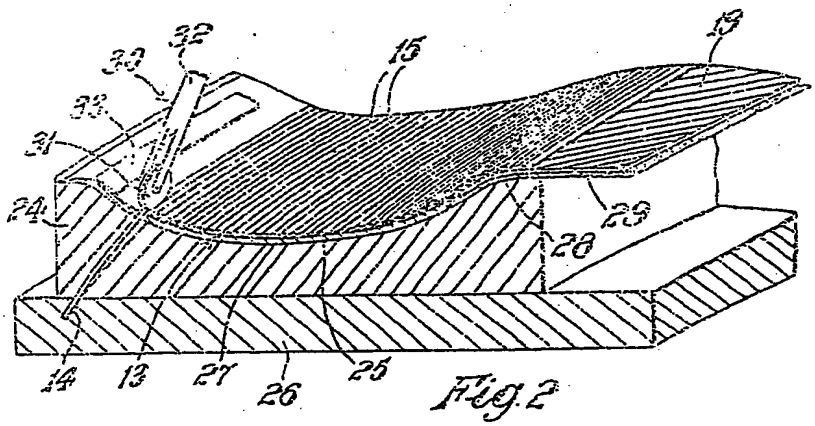

Fig. 2

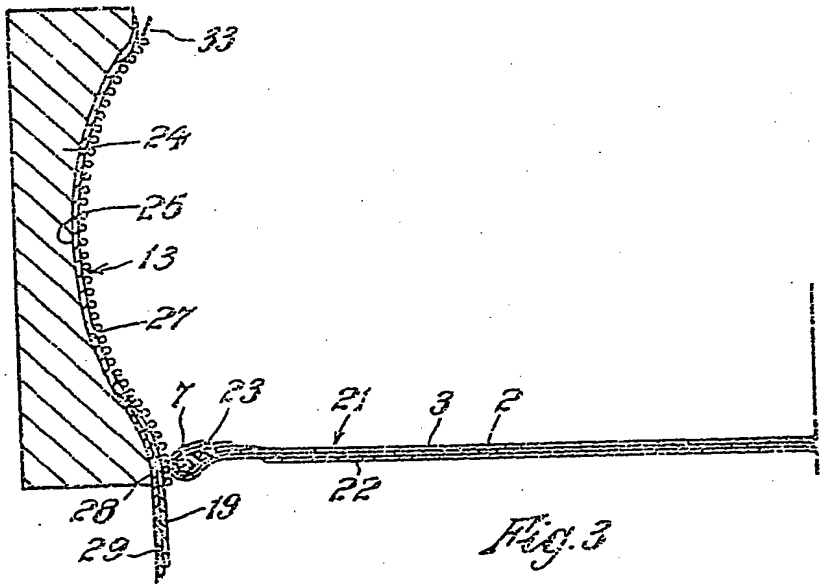

Fig. 3

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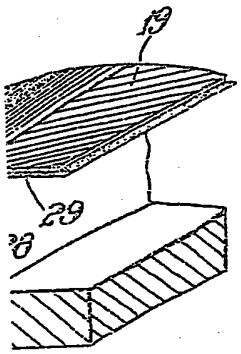
3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheets 2 & 3



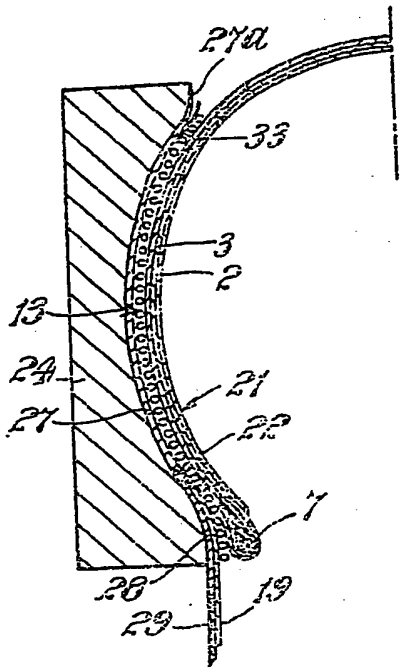


Fig. 4

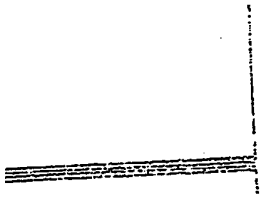


Fig. 3

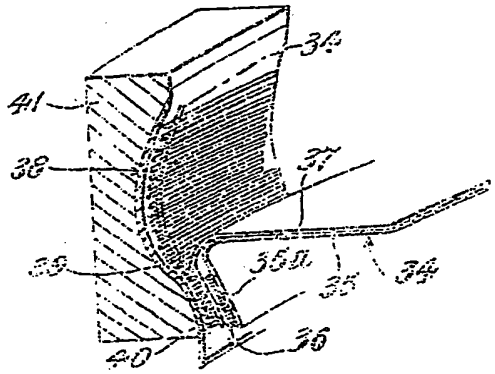


Fig. 5

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Sheets 2 & 3

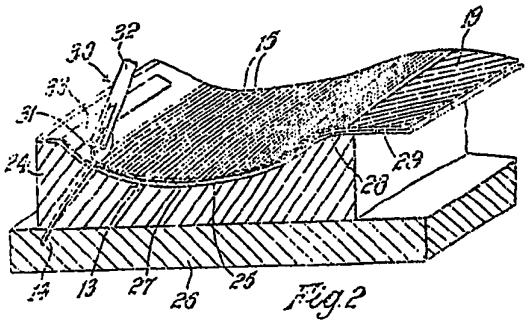

Fig. 2

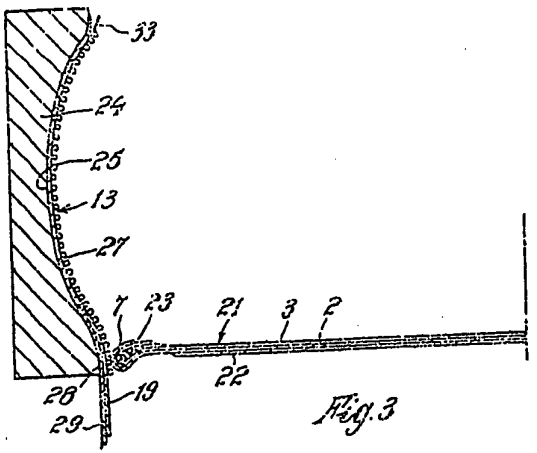

Fig. 3

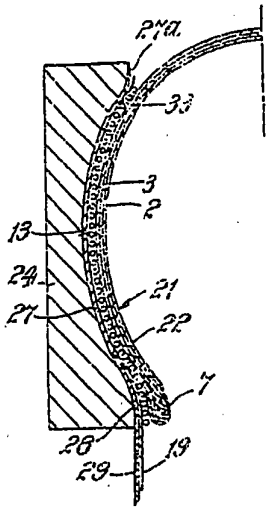

Fig. 4

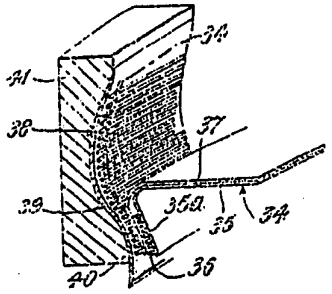

Fig. 5

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